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Pre-Release 1

Checkout and Launch Control System (CLCS) System Engineering Management Plan

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Checkout and Launch Control System (CLCS)

System Engineering Management Plan

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1.0 Technical Program Planning and Control

The CLCS System Engineering Management Plan will be used in conjunction with the CLCS Configuration Management Plan, the CLCS Program Management Plan, CLCS Project Management Plan along with the implementation of the documents called out on the CLCS Documentation Tree to provide the official standards and procedures that the CLCS project will adhere to.

In addition, CLCS will use MIL-STD-498 as a guiding system engineering resource for System Engineering Management processes. MIL-STD-498 was approved for use on December 5, 1994, superseding DoD-STD-2167A. Two guidebooks supporting MIL-STD-498 were released in January 1996: Overview & Tailoring, and Application & Reference. EIA and IEEE published a commercial version of MIL-STD-498 in January 1996 titled EIA/IEEE Interim Standard, Standard for Information Technology, Software Life Cycle Processes, Software Development, Acquirer-Supplier Agreement. MIL-STD-498 are available from the MIL-STD-498 home page on the World Wide Web.

CLCS will tailor the following MIL-STD-498 General Requirements to the processes and procedures discussed and referenced in the management plan

- Use systematic, documented software development methods
- Develop and apply standards for representing requirements, design, code, and test information
- Establish and apply strategies for handling critical requirements, such as those with safety, security, or privacy implications
- Analyze and fulfill the computer hardware utilization requirements.
- Record rationale for key decisions for use by the Kennedy Space Center support organizations.
- Provide reasonable access to developer facilities and products
- Reuse software products as appropriate:
    - Evaluate reusable software products for use in fulfilling CLCS requirements; incorporate those that meet the criteria in the CLCS Software Development Plan
    - Identify opportunities for developing software products for reuse.

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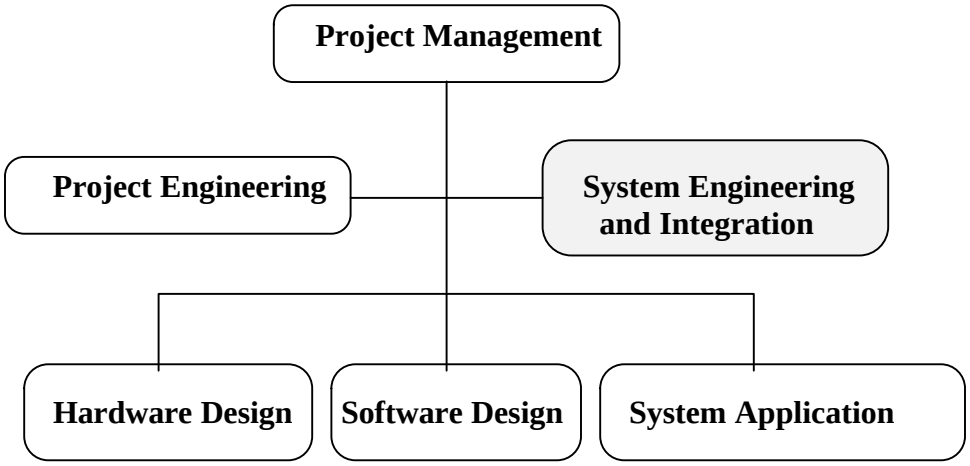
This document will also provide a guideline for training and orientation of CLCS personnel at all levels.

1.1 System Engineering and Integration (SE&I) Responsibilities and Authority

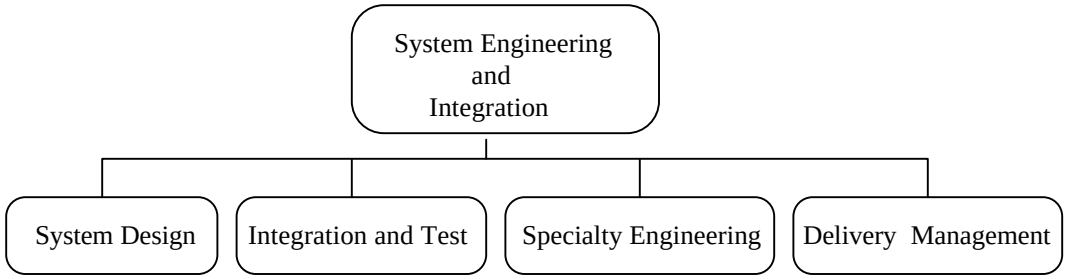
The CLCS Project will be managed according to the following organizational chart.



System Engineering and Integration will provide direct support to the CLCS NASA Project Managers. The System Engineering and Integration Division is responsible for the following:

- Project level strategic planning and coordination.
- System level hardware, software, platform, and network architecture development and implementation.
- System level requirements capture, reliability and maintainability analysis and security engineering, pre-production configuration management.
- System level integration and test certification plans, and the coordination of technology studies.

The System Engineering and Integration Division is further organized in the following manner:



1.1.1 System Design Group

The System Design Group is responsible for the complete CLCS system level design architecture. System Design is the lead organization that coordinates and directs the CLCS System Design Team. This design responsibility includes coordinating and implementing the system Hardware Architecture, Software Architecture, Sub-system design, Network Design, and all external interfaces to CLCS.

The System Design Group is responsible for providing a strategic engineering function to the CLCS project management team. This function involves the systematic definition of future delivery contents, and future delivery threads. Significant system issues will be 'mapped-out' for resolution against the project schedule.

In addition System Design is responsible for capturing, refining, and controlling the system level requirements documented in the CLCS System Level Specification.

System Design is responsible for completing and keeping up to date the following CLCS documents:

- CLCS System Level Specification
- CLCS Design Description Document
- CLCS External Interface Descriptions

Finally, the System Design Group supports the CLCS delivery definition phase through the management and coordination of the Delivery Thread Definition Team. The System Design Group provides the initial Delivery Document that will be used to start the delivery Design Panel Process.

1.1.2 Integration and Test

CLCS System Integration and Test is responsible for the complete system level integration of delivered products and testing all delivered products to insure that all system level specifications and product level specifications have been met. In addition, Integration and Test is responsible for providing direction and coordination of the system level configuration management policies and procedures, and the system set build policies and procedures.

System Integration and Test is responsible for completing and keeping up to date the following CLCS documents:

- CLCS System Test Plan
- CLCS Verification Plan
- CLCS Configuration Management Plan
- CLCS Delivery Specific Test Plan and Procedures

1.1.3 Specialty Engineering

Specialty Engineering is responsible for providing particular system level engineering support in Security, Safety Engineering, Reliability and Availability Engineering, Maintainability Engineering, Human Factors Engineering and Logistics Engineering. While most of the functions described here are Kennedy Space Center support organizations; Safety and Mission Assurance (SMA), Logistics Engineering (LO) for example, Specialty Engineering will be responsible for coordinating and directing these activities per project level direction.

Specialty Engineering is responsible for providing system level model performance analysis engineering support. Performance modeling will be based around a performance modeling and analysis tool and will be responsive to the needs of the System Engineering System Design Group.

Specialty Engineering is responsible for the following CLCS documents:

- CLCS Safety and Mission Assurance Plan (including Software Product Assurance and Software Quality Assurance)
- CLCS Failure and Error Mode Analysis Plan
- CLCS Logistics Plan
- CLCS Maintenance Plan
- Human Factors Standards

1.1.4 Delivery Management

CLCS Delivery Management is responsible for providing support, on a delivery based focus, to the CLCS Project Managers. This support includes product development schedule tracking, procurement schedule tracking, integration tracking, facility modification schedule tracking, and final delivery verification and accountability. Also, Delivery Management is responsible for providing insight to technical problems that could result in a delivery schedule slip.

CLCS System Delivery Management is responsible for providing, on a weekly basis, a status of products that are considered part of a CLCS delivery as captured in the specific Delivery Definition Document.

Delivery Management is responsible for providing the following CLCS documents

- Delivery Manager's Weekly Report
- Delivery Manager's Production Schedule
- Delivery Integration Schedule

Delivery Management is responsible for providing updates and corrections to the Delivery Definition Document.

2.0 System Engineering Project Control

2.1 Project Level System Engineering

2.1.1 Responsibility and Authority

The System Engineering and Integration Division is responsible for providing the technical direction, leadership, and coordination of the CLCS Project. System Engineering and Integration in conjunction with CLCS Project Engineering will also implement the system design and system procedures to insure that all project level goals and guidelines are met.

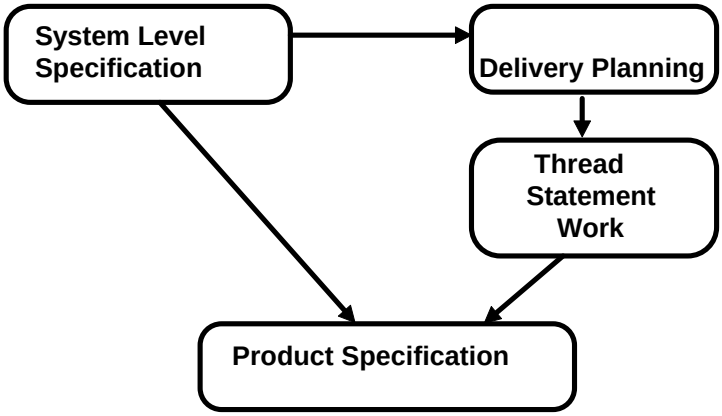
2.1.2 Major Deliverables

The System Engineering and Integration Division is responsible for providing and controlling the following program level documents and specifications.

System Level Specification
System Design Document
System Test Plan
System Certification Plan
System Operational Concept

2.1.3 CLCS Requirements Analysis and Capture

CLCS Requirements analysis and capture process is shown in the following diagram. The Delivery Planning process and Thread Statement of work are discussed in Section 2.2



2.1.3.1 System Level Requirements

System Level Requirements are captured in the CLCS System Level Specification. These system level specifications will be generated/derived from the following sources:

- Existing Launch Processing System Requirements
- LPS user requirements inputs
- Shuttle Upgrade Project Requirements
- External to LPS System Interface requirements (ie. Ground Measurement System, HAZ GAS)
- KSC Resident CCMS, CDS, RPS, expertise

The System Level Specification (SLS) will be a living document. It will be under configuration control after the first Project Architectural Baseline Review. Changes, corrections, and additions to the SLS will be completed under the guidelines called out in the CLCS change control process which is discussed later in this document.

The requirements captured in the System Level Specification will be allocated to the appropriate CSCIs and HWCIs as part of the document or as part of the design activity. The delivered CSCIs are designed, tested, and accepted to the product level requirements. The system level specifications which could be considered as "Level A" requirements are incrementally met with each delivery. The level of user acceptance and user certification is directly proportional to the delivered incremental completeness of the system level specifications that have been met in a delivery. This approach to user acceptance is discussed in detail in the CLCS Certification Plan.

CLCS HWCIs are primarily Commercial-Off-The-Shelf (COTS) products. HWCIs are specified and procured according to the system level specifications and product level specifications. If unique CLCS requirements preclude using a COTS product then that specific HWCI will be custom designed.

2.1.3.2 Product Level Specifications

The product level requirements, also called the product specifications, are captured and analyzed during the Design Panel Process. In particular the Requirements Design Panel reviews the product specifications. The product specifications are what the delivered CSCI/HWCI products will be tested to at delivery acceptance.

The Product Level Specifications are incorporated into the Software Requirements and Design Documents and the Hardware Requirements and Design Documents which are organized by CSCI or HWCI.

2.1.4 System Level Design Reviews

The CLCS development process will be a hybrid of the evolutionary and incremental approaches discussed in MIL-STD-498. Project deliveries, successively built upon each other, will incrementally satisfy the functional requirements. The "classical waterfall" approach to delivery definition, requirements capture, design, and acceptance will be incrementally completed during each CLCS delivery. In effect, every delivery is a "mini project" in that part of the overall system to be developed is provided in periodic "drops" or releases. MIL-STD-498 refers to these drops as "builds"

The classical approach to project reviews will also be accomplished in an incremental fashion. CLCS project management will insure that the system level reviews are not a "make work" type of activity. Rather, the reviewing process is incorporated into the design process with a series of project level "snap shot" reviews scheduled at key times in the project life cycle.

2.1.4.1 System and Project Reviews

Periodically and at the discretion of the CLCS Project Manager system level reviews will take place. These reviews will be tailored to specific issues that require the acceptance and consensus of the CLCS Project Management chain. These reviews include Architecture Baseline Reviews and Project Status Reviews. These reviews will be timed, and the agenda will match the significant system engineering activities that the CLCS Project Manager deems necessary for a high level review. The intent of these reviews are described in MIL-STD-498.

The System and Project Reviews will be scheduled at least a two months in advance of the event and all presented material will be made available one week before the scheduled review.

In addition, CLCS will have a System Preliminary Design Review and a Critical Design review. These reviews will not be the traditional types of status reviews but will be tailored to specific milestones on the CLCS schedule surrounding COTS procurement activities.

2.1.4.2 *Incremental* Preliminary and Critical Design Reviews

MIL-STD-498 describes the development process and the reviewing techniques for both incremental and evolutionary type projects. CLCS represents a hybrid of these two types of projects. CLCS will meet the intent of MIL-STD-498 through system level and project level reviews and in particular the design panel process.

The design process is divided into three distinct phases. The Concept Design Panel, the Requirements Design Panel, and the Detailed Design Panel each will focus on specific processes and activities in the delivery of the project CSCIs and HWCIs.

The Concept Design Panel, the Requirements Design Panel, and the Detailed Design Panel will incrementally provide the same level of review that the classical Preliminary Design Review and the Critical Design Review would as outlined in the outdated MIL-STD-2167. The significant difference to the method that CLCS will meet what is called out in MIL-STD-2167 is that the project will do this on a delivery basis. That is, as the development of the system CSCIs and HWCIs progresses through the life of the project, they will be reviewed at each incremental delivery with respect to the system level requirements and product level specifications that are being met. This method reduces the overhead of the "big bang" approach of design reviews and also provides a method of course correction throughout the development process that will minimize project cost impacts.

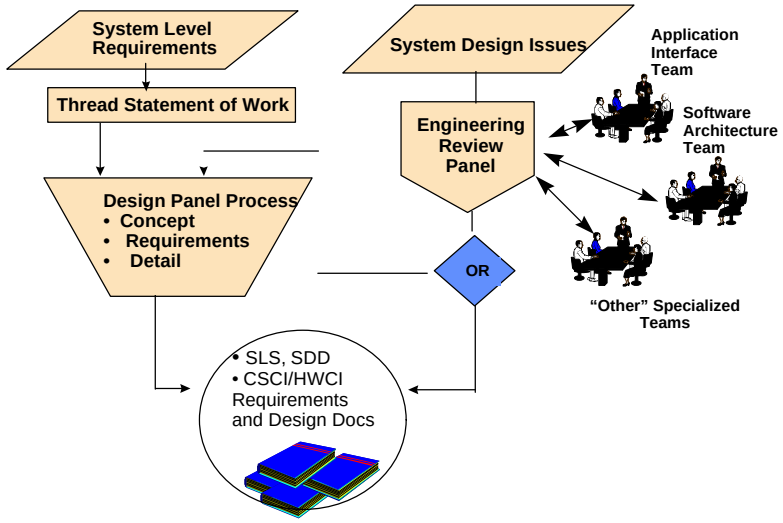
2.2 System Analysis and Control

This section of the System Engineering Management plan will cover the System Engineering role in delivery definition, product assessment, and the process that will be employed to manage the development cycle and provide the equivalent of incremental preliminary design reviews and critical design reviews.

2.2.1 System Design Process

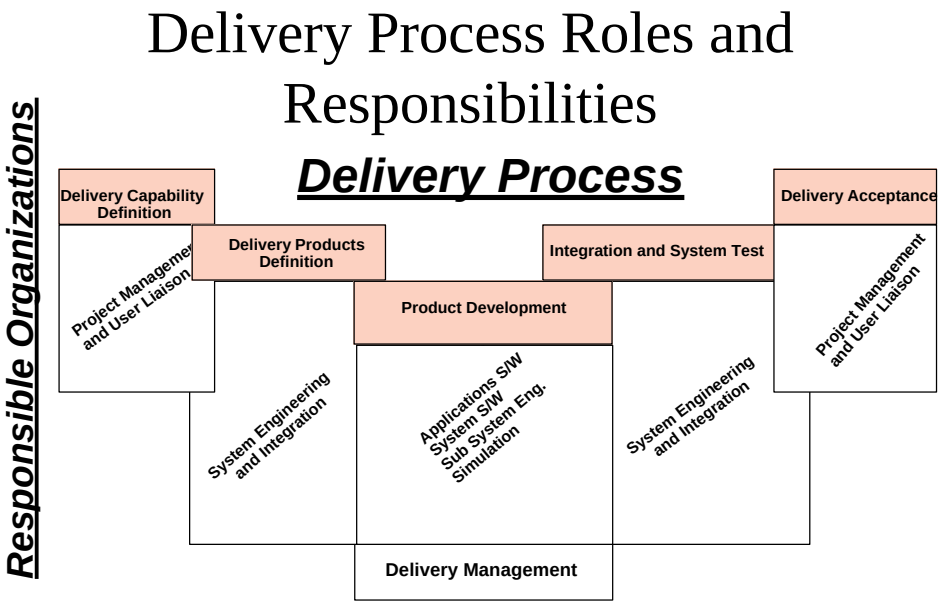
The CLCS system design process is broken down into two major activity processes. The following illustrates this breakdown.

CLCS System Design Process



The CLCS system design will be completed through the interaction of the incremental delivery process and the resolution to specific system level design issues. Delivery based system design is the left hand side of the diagram and represents the process of translating system level requirements, captured in the CLCS System Level Specification, into Thread (capability) statement of works. This design activity is governed by the Design Panel Process. On the right hand side of the diagram the process of system design issue resolution is represented. The following paragraphs will discuss these processes and their interaction in detail

2.2.1.1 System Design and The Delivery Process



2.2.1.2 CLCS Delivery Capability Definition

A strategic system engineering analysis will be performed in advance of delivery start. Each delivery is mapped out to meet specific and measurable project goals. Providing capabilities to the user community at the earliest possible time, while constraining the delivery to a reasonable work content, is the goal of this activity.

The delivery definition phase begins with a written agreement between CLCS Project Management and the User Liaison office that indicates the specific capability of a project delivery.

1. Capabilities Provided For Operational Support
2. Facility Considerations
3. Affected External Organizations

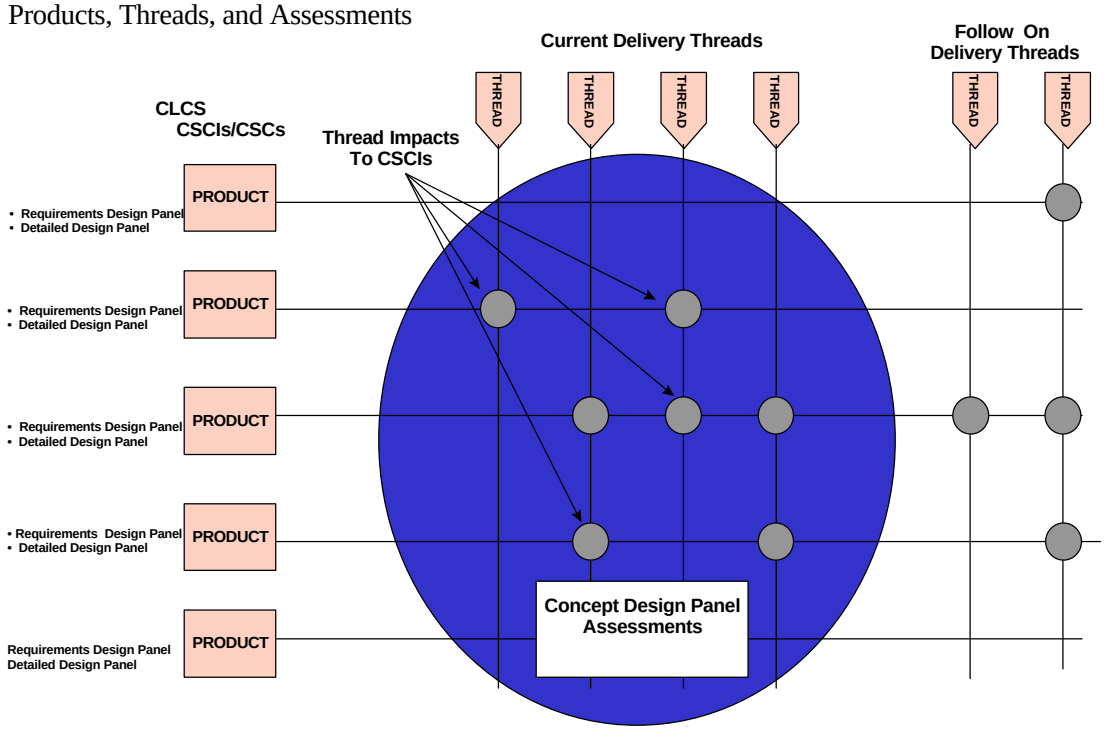
The Five Year Project Schedule and Project Effectivity and Milestone chart, as well as the Strategic Engineering function discussed earlier will be used to facilitate this definition agreement activity.

2.2.1.3 Threads

System Engineering and Integration will use the concept of a system “thread” to capture a set of capabilities for each delivery. Threads are a system wide view of all software products (CSCIs/CSCs) and the hardware products (HWCIs) that a system capability relies on. The following diagram illustrates the product and thread/capability relationship.

As the threads are defined for a specific delivery, they ‘impact’ the project CSCIs/CSCs/HWCIs. The intersection of the vertical lines (delivery threads) with the horizontal lines (CSCIs/CSCs/HWCIs) represent the assessment of the work required to provide the capabilities of the delivery.

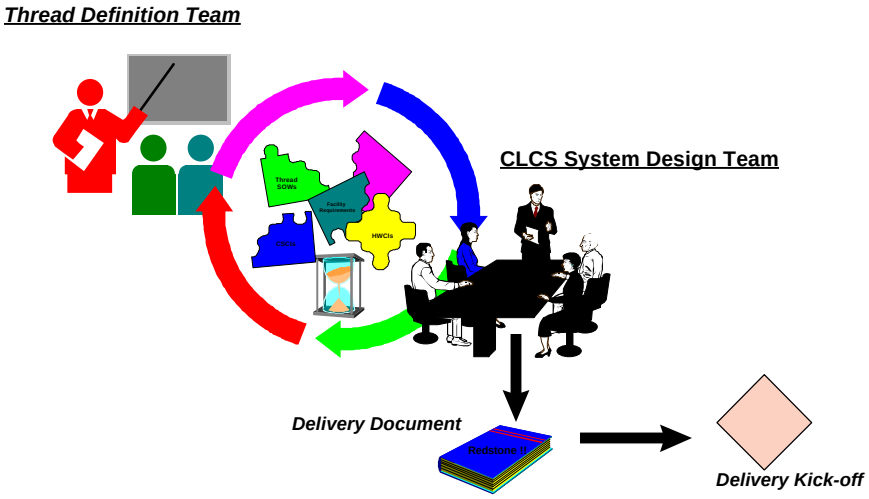
Products, Threads, and Assessments



2.2.1.4 Thread Definition

Thread definition is the initial activity for a delivery. The thread definitions are made by the Thread Definition team, a subset of the CLCS System Design Team. The Thread Definition team will include participation from the User Liaison throughout the process. This process captures the required capability that the CLCS CSCIs/CSCs must provide. The outcome of this definition phase is the Delivery Definition Document. The figure below illustrates this process.

Thread Definition Process



2.2.1.5 Delivered Products

CLCS delivered products are organized in general categories

1. Thread Based Products
2. Non-thread Based Products

Thread based CSCIs/CSCs are software products that have been developed in accordance to the allocated system level specification and the product level specifications. These products are described by the thread but stand on their own as configuration managed deliverables.

A thread is not a delivered product. A thread describes the capabilities of all associated CSCIs/CSCs and thereby provides impacts to these products. In fact, the word thread could easily be replaced by the term 'system capability'

Non-Thread Based products are those items that include, but are not limited to, the following:

1. Prototype Products (eg. Console Enclosures, COTS product evaluation)
2. Trade Study outcomes
3. CSCI and HWCI development that is in direct support of a capability that is described by a later delivery thread.
4. System software CSCIs such as operating systems, design tools, etc.
5. Facility modifications

While these types of delivered products are not necessarily categorized by a thread, they are included in the project work breakdown structure and are tracked and managed accordingly.

2.2.1.6 Delivery Definition Document

The CLCS Delivery Documents describe all of the threads and products that make up a delivery. It is produced by the CLCS design team at the start of the delivery definition and matured as the thread assessments solidify. It is a living document until the successful completion of the Concept Design Panel(s) where it then becomes the official agreement between Project Management, the User Liaison, System Engineering and Integration and the development organizations defining the work that will be performed and the products to be provided as part of the incremental delivery.

Once the delivery document has been released, the project delivery manager begins to build the delivery schedule through which the product development will be tracked.

2.2.2 System Design and Issue Resolution Process

The next sections discuss the right hand side of the diagram illustrating the CLCS system design process. This is the system Issue resolution and design process.

2.2.2.1 System Issue Identification

System Issues are identified from a variety of sources. These are technical design challenges that have been recognized by any of the following:

- The User Community
- Project Management
- External Considerations
- Thread Definition
- CSCI and HWCI Development
- System Test and Acceptance activities

Once an issue has been identified, it will be documented in two different ways. If an issue has been identified during a design panel, it will be captured as part of the official minutes of the design panel. Other issues that are identified outside of the design panel process will be captured using a CLCS System Issue Form.

The System Issues not captured as part of the design panel process will be kept in a database that will be available to the subs-system developers. This allows the system design team to record and track the system issues for the timely disposition and resolution.

It is the responsibility of the lead of the Engineering Review Board to accurately record and track the disposition of each system issue.

2.2.2.2 System Issue Screening and Disposition - Engineering Review Panel

The Engineering Review Panel is responsible for coordinating all technical system level issues and providing disposition. The Engineering Review Board is made of members from System Engineering the development organizations.

As part of weekly activity the Engineering Review Panel will conduct system issue screening and disposition activities. This process is to review the list of issues, prioritize the issues and provide the coordination and direction to the individual system engineer or sub task team(s) for issue resolution. As part of the Engineering Review Board , the CLCS System Design Lead will coordinate the issue dispositions and insure that all resolutions are documented in the same database that the issue was first captured. The CLCS System Design Lead will follow closely the design panel activities in order to provide timely resolution and facilitate a consistent system wide design.

2.2.2.3 Sub Team Tasking

If a specific issue requires a team of system and sub-system engineers for complete resolution, the System Design Lead will direct one or more Sub Task Teams to provide resolution. These teams will be held accountable for complete issue resolution with System Engineering and Integration oversight and coordination.

The Applications Interface Team (AIT), the Sub-system Software Architecture Team, are two examples of the types of sub teams that are discussed in this section. The teams consist of members from across the CLCS design and development divisions as well as System Engineering and Integration.

2.2.2.4 Specific Types of System Level Issues and Other Design Review Panel Topics

2.2.2.4.1 Trade Studies

Trade studies will be scrutinized by the Engineering Review Panel. CLCS will use trade studies to provide information to make informative decisions regarding system level architecture decisions. These trade studies will not necessarily go through the all of the types of design panels but rather will only go through those that are appropriate.

The outcome of the trade study will be a document that describes the process used for the trade study and the recommendations regarding the item or process under consideration.

2.2.2.4.2 System and Application Software Re-use Considerations

Consideration of software re-use is a fundamental part of the CLCS project development process. During the course of the project, the software developers will identify opportunities for obtaining software products for reuse and will evaluate the benefits and costs of these opportunities. Opportunities that provide cost benefits and are compatible with program objectives will be identified. In particular, though not exclusively, the system software and applications developed as part of the Mission Control Center (MCC) project at the Johnson Space Center will be ported and re-used in the CLCS architecture where the appropriate system level and product requirements are synergistically compatible. This section of the System Engineering Management plan will discuss the processes and procedures to incorporate the MCC products and services into the CLCS architecture.

The developer will identify and evaluate reusable software products for use in fulfilling the requirements of the CSCI. The scope of the search and the criteria to be used for evaluation is described in the software development plan. Reusable software products that meet the criteria will be used where practical.

General criteria will be the software product's ability to meet specified requirements and to be cost-effective over the life of the system. Examples of specific criteria include, but are not limited to:

a. Ability to provide required capabilities and meet required constraints
b. Ability to provide required safety, security, and privacy
c. Reliability/maturity, as evidenced by established track record
d. Testability
e. Interoperability with other system and system-external elements
f. Fielding issues, including:
    1) Restrictions on copying/distributing the software or documentation
    2) License or other fees applicable to each copy
g. Maintainability, including:
    1) Likelihood the software product will need to be changed
    2) Feasibility of accomplishing that change
    3) Availability and quality of documentation and source files
    4) Likelihood that the current version will continue to be supported by the supplier
    5) Impact on the system if the current version is not supported
    6) The acquirer's data rights to the software product
    7) Warranties available
h. Short- and long-term cost impacts of using the software product
i. Technical, cost, and schedule risks and tradeoffs in using the software product

2.2.2.4.2 .1 Interpreting MIL-STD-498 activities for reusable software products

The following rules apply in interpreting this standard:

a. Any requirement that calls for development of a software product may be met by a reusable software product that fulfills the requirement and meets the criteria established in the software development plan. The reusable software product may be used as-is or modified and may be used to satisfy part or all of the requirement. For example, a requirement may be met by using an existing plan, specification, or design.

b. When the reusable software product to be incorporated is the software itself, some of the requirements in this standard require special interpretation. Key issues are whether the software will be modified, whether unmodified software constitutes an entire CSCI or only one or more software units, and whether unmodified software has a positive performance record. The criteria for each software re-use candidate will be established on a case by case basis by the Engineering Review Panel.

2.2.2.4.2 CLCS Procedures and Processes for Software Reuse Activities

As early in the project development cycle as possible, candidate re-use software should be designated by the System Engineering and Integration Division. Timing is critical availability of the software to be re-used must coincide with the CLCS delivery process.

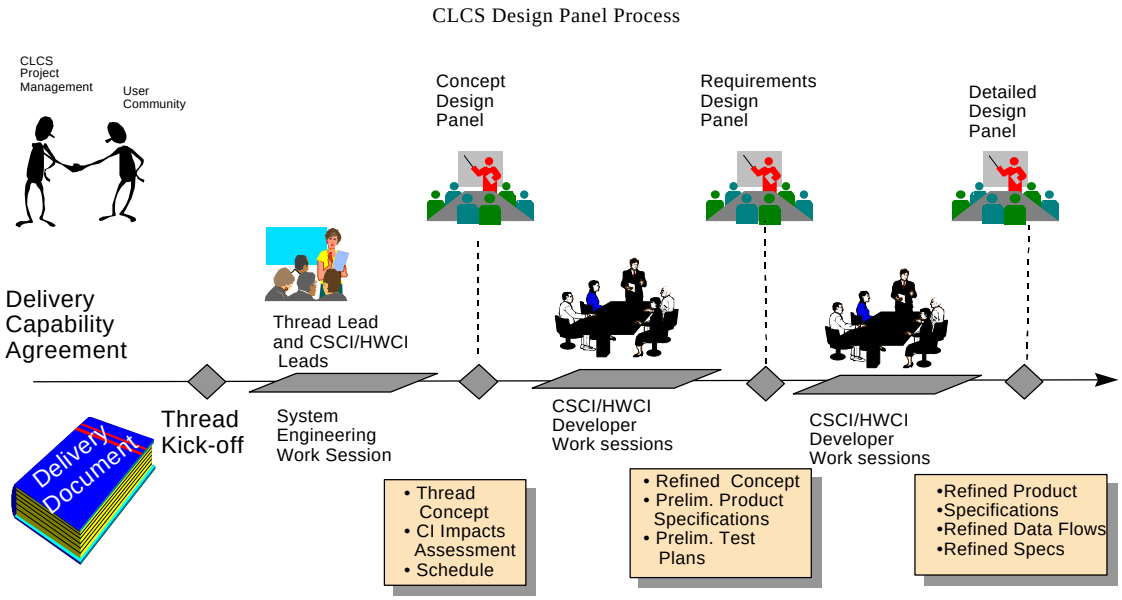
Representatives, designated by the Chief of the System Engineering and Integration division from System Engineering And Integration, System Software, and Application Development will work together to determine the adequacy of a reuse of software. This process will begin with an evaluation of requirements matching between CLCS system level specifications and product specifications to those of the candidate reusable software. The evaluation will determine one of three possible outcomes for the candidate software.

1. Complete Re-use with no modification other than possible platform porting considerations.
2. Re-use with modifications.
3. No re-use due to the overwhelming required modifications.

The reviewing team will provide a written assessment of each candidate software. The evaluation process should average no longer than three weeks.

In order to facilitate this process a path finding CSCI such as Timer Services from the Mission Control Center will be evaluated for use as the CLCS Timer Services. This path finding exercise will take place early in the project life cycle.

2.2.3 CLCS Design Panel Process



2.2.3.1 Responsibility and Authority

The CLCS design panel process is the responsibility of the System Engineering and Integration Division. The lead of the SE&I Division is by definition the Design Panel Chairman. The design panel chairman has the authority to designate two Design Panel Co-Chairmen. It addition, a Design Panel Secretary will be designated.

The Design Panel Chairman has the responsibility to coordinate the internal design panel meetings and provide/publish the agenda for the official design panels. The chairman has the responsibility to conduct

the design panels, direct any actions to be worked, and insure that configuration control of the design panel products is provided.

The Design Panel Secretary is required to take notes during the official design panel meetings and track any actions. The actions captured in a design panel will be tracked according to the issue tracing procedure as discussed earlier in this document. In addition, the Design Panel Secretary will provide an archive (hard copy) of each design panel, along with an attendance list of the panel participants.

2.2.3.1.1 Thread Leads

The primary responsibility of a thread lead is to provide the system level engineering expertise for the thread assessment phase of a CLCS delivery. The thread lead will coordinate and capture CSCI and HWCI assessment impacts that will be documented using the thread assessment template.

The thread lead is responsible for providing delivery dependencies to the Delivery Manager using the CLCS Dependency Form. These dependencies will be incorporated into the Delivery Manager's Production Report.

The thread lead's job is not finished at the completion of the Concept Design Panel. After the successful completion of the thread assessment the thread lead will monitor and provide system level design guidance for the development of the individual CSCIs and HWCIs that were impacted by the capability provided by a particular thread. The thread lead will provide system engineering expertise throughout the CSCI and HWCI development cycle when an issue of requirements and/or capability requires resolution. In addition, the thread lead will provide system level engineering expertise to the Integration and Test group from the time that the assessment is complete.

2.2.3.1.2 CSCI Leads

The primary responsibility of the CSCI leads is to direct and coordinate software development for a particular CSCI throughout the life of the CLCS project. The CSCI lead will support thread leads for impact assessments during the delivery definition phases of the project. In addition , the CSCI lead will coordinate and capture the product level specifications that will be provided for a specific delivery.

The CSCI lead's job is not delivery centric. The CSCI lead is responsible for providing a delivery based capability, but this incremental capability is considered the process by which the complete CSCI product will be delivered by the end of the project. The CSCI lead is required to respond to the delivery manager for status and provide insight and engineering expertise when a scheduled delivery capability is in jeopardy.

2.2.3.2 System Software Requirements and Design Document

2.2.2.3.2.1 Requirements Allocation

CLCS System Level Requirements, which are captured in the CLCS System Level Specification, are *allocated* to CSCIs. These allocated system level requirements are met *incrementally* by the delivery

based developed capability of the project CSCIs and HWCIs. This allocation is indicated in the System Level Specification.

The CSCIs and HWCIs that are impacted to provide a capability at each delivery are developed to meet all appropriate product level specifications. These product level specifications (alternately called product requirements) are a natural flow down from the design panel process and are documented in the Software Requirements and Design Document.

The CLCS System Software Requirement and Design Document captures the complete software design of CLCS on a CSCI basis. This document is the responsibility of the Software Design Division. The input for the Software Requirements and Design Document is provided by the approved outcome from the CLCS Design Panel Process.

2.2.2.3.2 Hardware Requirements and Design Document

The CLCS Hardware Requirements and Design Document captures the complete hardware design of CLCS on a HWCI basis. This document is the responsibility of the Hardware Design Division. The input for the Hardware Requirements and Design Document is provided by the approved outcome from the CLCS Design Panel Process.

2.2.3.3 Concept Design Panel

The Concept Design Panel is the first review that will take place for an initial CLCS delivery or a change impact to a previously delivered product. The material is presented by a member of the System Engineering and Integration Division or another engineer acting on behalf of SE&I. This presenter is considered the "Thread Lead" for a particular thread for a particular delivery.

The purpose of the Concept Design Panel is to provide an assessment of the work required to meet all delivery capabilities. To achieve this the thread lead does the following:

1. Completion of the Thread Assessment Using the Concept Design Panel Template
2. Coordinate interface requirements and system level functionality with the appropriate CSCI/CSC, and HWCI leads.
3. Present the Thread Assessment Information at the Concept Design panel.
4. Provide input into the Software Requirements and Design Document.

The Presentation Package for the Concept Design Panel consists of:

1. Section 1 of the thread assessment template.
2. Section 2-4 available for "back-up" data and not necessarily presented.

The following products are provided by the successful completion of the Concept Design Panel and are incorporated into the Software Design Requirements and Design Document.

1. High Level System Overview of Thread Capability.
2. System Level Requirements Satisfied by the delivery of the capability described by the thread.
3. Assessments in "labor-months" to complete the work for the delivery.
4. A change controlled Delivery Document.

2.2.3.4 Requirements Design Panel

The purpose of the Requirements Design Panel is to provide a review of the Product Specifications/CSCI sub-system requirements and preliminary design. The Requirements Design Panel is a review focusing on the CSCI/CSCs , HWCIs that were assessed in the Concept Design Panel. The CSCI/HWCI specifications/requirements are what will be tested to at the integration and delivery verification phases of the project. These specifications/requirements are derived from the allocated system level specification. The material for the Requirements Design Panel is presented by a CI Lead or a CI Lead delegated presenter .

The Requirements Design Panel HWCI/CSCI Lead responsibilities are:

1. Completion of the CSCI/CSC HWC I Requirements Capture Using the Requirements Design Panel Template
2. Coordinate interface requirements and system level functionality with the Thread Leads.
3. Present the Product Specifications/Requirements at the Requirements Design panel.
4. Present HWCI/CSCI Preliminary Design information
5. Provide input into the Software Requirements and Design Document or the Hardware Requirements and Design Document.

The Presentation Package for the Requirements Design Panel consists of:

1. The CSCI/HWCI Requirements template.

2.2.3.4.1 Requirements Allocation and Product Specification

Incorporated in the CLCS System Level Specification is an allocation of system level requirement to CSCIs/HWCIs. The Requirements Design Panel is the official record of the specifications and requirements that the CSCI/CSC, HWCI has been developed and delivered to satisfy. The requirements allocation is traced by CSCI/CSC, HWCI name.

2.2.3.4.2 Testing and Integration Considerations

At the successful completion of the Requirements Design Panel, the System Integration and Test Team will begin to document the delivery specific integration plan. The plan will describe the specific implementation of the delivery based test cases as well as any regression testing if necessary.

System Level Testing of the delivered capability is organized by threads. The system level testing is completed against the product level specifications and the system level specifications where appropriate.

The test cases will be based upon the System Level Specifications, the Functional/Product level specifications and threads.

2.2.3.5 Detailed Design Panel

The purpose of the Detailed Design Panel is to provide for a final review of the work to be performed to meet the product specifications/requirements that were captured in the Requirements Design Panel .

The Detailed Design Panel is a review focusing on the CSCI/CSCs and the HWCIs that were assessed in the Concept Design Panel and how the captured requirements are to be met. The material is presented by a CSCI Lead or CSCI Lead delegated presenter . The focus of the review is on CSCI/HWCI external interfaces and on the appropriate test plans.

The Detailed Design Panel provides a system level review of the design of the CSCI/CSC, HWCI. To achieve this the CSCI/HWCI lead presents the following:

1. Any changes that have been made to the Requirements Design Panel information
2. Update of Ground rules and Assumption
3. External Interface detailed test plan

2.3 System Level Design Documentation

2.3.1 System Level Specification

The CLCS System Level Specification identifies the system level requirements that are the basis for the development of the project. It contains requirements for the Real-Time Processing System (RTPS), Shuttle Data Center (SDC), Simulation System (SIM), and the Business and Information Network (BIN). The document is organized into five subsections. The first subsection contains the requirements that apply to more than one of the major CLCS subsystems. The remaining four subsections contain the requirements specific to each of the major CLCS subsystems:

1. Real-Time Processing Requirements
2. Business and Information Network Requirements
3. Shuttle Data Center Requirements
4. Simulation Requirements

The SLS will use as a reference and in some cases, the initial requirements capture, the existing Launch Processing System documentation.

2.3.2 System Design Document

The CLCS System Design Document identifies and describes the system level design for the Checkout and Launch Control System. It contains descriptions for the Real-Time Processing System (RTPS), Shuttle Data Center (SDC), Simulation System (SIM), and the Business and Information Network (BIN). The document will consist of various volumes that will document the system and sub-system designs of the CLCS.

2.4 Change Control Process

The boards, policies and procedures that make up the change control process for CLCS are discussed in detail in the CLCS Control Board Charter (84K00006) and the CLCS Configuration Management Plan (84K00027). The process applies to every configuration-controlled document and the systems they represent. The process discussed in this System Engineering Management Plan will adhere to all of the guidelines and procedures discussed in those plans.

The CLCS change control process will consider the following items that are discussed in the CLCS Configuration Management Plan

- Configuration Identification - Selecting those items that will be placed under configuration control and when they will be controlled
- Change Control including the following products and procedures
    - CLCS Development Tools
    - CLCS Master Document Library
    - CLCS Software Library
    - Released/Delivered Software
    - Change Requests
    - Engineering Support Requests
    - Requirements changes and additions

    - Test Plans

- Configuration Status Accounting - Provide accurate and complete status of a delivery document and all of the appropriate changes that are being tracked.
- Configuration Audit - The process of verifying the delivered products and services against the product level specifications and system level specifications.

Problem reports (PR's) also flow in the change control process and are tracked by the Configuration Management Process. (Reference the Safety and Mission Assurance (S&MA) Plan). A nonconformance or problem is documented on a PR form, and appropriate signatures are obtained. The PR, along with supporting material, is forwarded to the Change Control Manager for Change Screening Panel (CSP) action. CSP will review the PR package and disposition as either approved for implementation or disapproved and closed.

2.5 Safety and Mission Assurance

2.5.1 Roles and Responsibilities

The CLCS Project will provide management, planning, and implementation of safety and mission assurance (safety, reliability, maintainability and quality assurance) functions, including the quality assurance required for inspection services. The policies and procedures established for accomplishing the S&MA tasks will be an integral part of the project effort and documented in the Safety and Mission Assurance Plan. The plan will provide for early implementation of S&MA tasks during development. All requirements derived from the Safety and Mission Assurance Plan will be carefully and conscientiously documented, implemented and traced to ensure total project support.

2.5.2 Safety and Mission Assurance Processes

2.5.2.1 Safety and Mission Assurance CLCS Support

CLCS is a NASA managed activity with contractor support provided under existing NASA contracts. S&MA support will be provided to the project by the Safety and Mission Directorate (EC). EC will provide the S&MA management with the contractors implementing support in accordance with provisions of their respective contracts.

2.5.2.2 Safety, Reliability, and Maintainability

The safety and reliability analysis will be performed to identify the risks associated with hazards or critical items in the CLCS system. Maintainability analyses will be performed to evaluate the design and to provide maintainability predictions which will influence the design, and provide data for logistics and maintenance planning. These analyses will be applied through out all phases of the life cycle, starting in the design phase, and maintained to assure a continual methodology exists for the reduction or elimination of potential risks.

2.5.2.3 Quality Assurance

Quality Assurance will be performed according the guidelines provided in the CLCS Safety and Mission Assurance Plan to provide adequate confidence that the CLCS Project conforms to the project requirements

2.5.2.4 Software Product Assurance

The Software Product Assurance Program is to assure the quality of all software and its documentation, and assure the quality of the processes used to produce software. Where possible, software product assurance activities will be accomplished on a non-interference basis (insight) using surveillance techniques and be applied in conjunction with the S&MA activities.

2.6 Integrated Logistics Support

2.6.1 Logistics Engineering

The Logistics Operation Directorate and its contractor support will provide support for the planning and the execution of logistics support for the development and implementation of the CLCS. The CLCS project staff will work together with the Logistics Operation Directorate to ensure adequate logistical engineering support throughout the development phase and to provide a smooth transition to the operational phase of the project.

The details of the Logistics Engineering is provided in the Checkout and Launch Control System (CLCS) Logistics Plan

2.6.2 Logistical Engineering During Development Phase

The primary objective of the Logistical Engineering organization for CLCS throughout the developmental phase of the project is to lay the foundation for operational logistical support that will be required when the CLCS becomes fully operational. To accomplish this support Logistics will:

- Provide Logistics recommendations to the CLCS project management after review of design data and documentation.
- Support the CLCS project team during the design panel reviews.
- Develop (or use existing) Logistics support plans and processes for :
    - Maintenance of COTS and unique/custom hardware.
    - Spares provisioning based upon a “life of program”, and “best industry practices”.
    - Training for CLCS operations and maintenance.
    - Supply support focusing on CLCS unique requirements.
- Prepares a Logistics life cycle cost estimate.

2.6.3 Logistical Engineering Support During Operational Phase

It is the intention of the CLCS project to provide an incremental capability for Shuttle processing support coincident with each delivery process. Therefore, a transition plan documenting the turn-over process will be developed based on the project schedule to ensure Logistics support is available at the time of each CLCS site activation. The scope and type of support will be determined prior to the initial operational delivery.

When CLCS becomes fully operational, Logistics is expected to implement the plans and processes that have been developed. This includes those activities described in section 2.6.2 and the following:

- Provide budget forecasts for continued logistics support of the CLCS.

- Perform all inventory management functions.
- Manage packaging, handling, storage and transportation processes for CLCS operational sites, including SAIL, Dryden, JSC.

2.7 System Security Support and System Integrity

2.7.1 Developed CSCI Security

As part of the CLCS development cycle, all System Engineering and Development Organizations will identify as security-critical those CSCIs or portions thereof whose failure could lead to a breach of system security. If there is such software, CLCS System Engineering and Integration will develop a security assurance strategy to assure that the requirements, design, implementation, and operating procedures for the identified software minimize or eliminate the potential for breaches of system security. The developer of this design and implementation will record the strategy in the software development plan, implement the strategy, and produce evidence, as part of required software products, that the security assurance strategy has been carried out.

2.7.2 Network Security

CLCS Network Security is the responsibility of Hardware Design Division. Essentially, the CLCS architecture will "plug" into the existing Kennedy Space Center network infrastructure. Using the existing LPS Operational Network (LON), and SODN for non-critical, non-control and command type data, insures that CLCS will adhere to the already established Kennedy Space Center network security processes and guidelines.

2.7.2.1 Network Security Processes

The CLCS network architecture is essentially made up three types of networks. The Real Time Control Network (RTCN), and the Display and Control Network (DCN) are used to transport all command and control data and commands. The Business Information Network is used to transport data between CLCS sets, as well as provide a method to access the KSC services and networks outside of the CLCS set environment.

The CLCS security processes include using COTS router technology to isolate the level 1 security interface to provide basic filtering capability. This process is similar to the method that is employed to isolate Kennedy Space Center from general Internet Access. A COTS firewall gateway will be installed between the level 1 and level 3 LON/CLCS Network. Supporting this configuration will be a network security monitoring system watching and logging all session activity on the level 1 network and access attempts to the level 3 system. The firewall will also provide activity logging and set alarms on violation attempts. Routers and firewalls will limit access between the Business Information Network and the CLCS control room systems. Masquerading firewall gateways will be installed between the command and control systems and any support networks to insure that addresses inside the command and control

systems are inaccessible from external systems. Also, the private address for the command and control networks because they will not pass through routers if the firewall technology is compromised.

2.7.2.2 Configuration Management Integrity.

The CLCS Configuration Management Plan discusses in detail the processes and procedures that will be employed when a CSCI is "promoted" from the development environment to the production (deployed) environment. As part of this process the appropriate software virus scanning applications will be employed to insure satisfactory integrity is maintained throughout the development and promotion process. The entire promotion process for a CSCI will be documented at each delivery for audit purposes. For further details of this procedure, see the CLCS Configuration Management Plan.

2.8 Program Risk Analysis

As discussed in the CLCS Project Plan the entire CLCS Project will support the Project Manager in the risk management process to assure all risks are identified, analyzed, mitigated, and tracked.

2.8.1 Delivery Definition Process

Risk Management of the CLCS process begins during the delivery definition phases. The CLCS mindset of risk management with user community involvement, which is discussed in the CLCS project plan, will be fostered by empowering the Space Shuttle Launch Processing Community through the User Liaison to influence and drive the project development process. The User Liaison in conjunction with project management and System Engineering and Integration will define the delivery capability and thereby providing the direction and guidance for delivery content.

This level of communication and direction enable the project management and the project development teams to remain close and candid throughout this phase of the project to insure that neither too much or too little is expected from a particular CLCS delivery. The ability to access potential risk to the delivery as well as the entire project completion is provided through this tightly coupled interaction.

2.8.2 Risk Management Through "Strategic" System Engineering Process

The CLCS System Engineering process is essentially two different simultaneous ongoing processes. The long range view, called strategic engineering, is concerned with employing the tools and processes that are discussed in detail as part of the CLCS Project Plan.

The System Engineering and Integration Division will support CLCS Project Engineering in providing realistic data and insight for use with the tools discussed in the CLCS Project Plan. The use of these tools at the project start-up as well as throughout the project development cycle will enable powerful risk mitigation to be implemented into the project. These tools include, but are not limited to Expert Interviews, Independent Assessments, Lessons Learned, Risk Templates, FMECAs and Fault Trees, Decision Analysis, Probabilistic Network Schedules, Probabilistic Cost and Effectiveness Models.

2.8.3 Risk Management Through "Tactical" System Engineering -- The Design Panel Process

After the delivery definition process risk management goes deeper into the CLCS system engineering process. The use of the incremental reviews as part of the design panel process allows project management, through the design panel chairman, to monitor and manage/mitigate project risk within the product development process.

The Concept Design Panel provides the overview that indicates whether the desired delivery capability is too ambitious for a single delivery. This allows the CLCS project management to coordinate resources to provide those capabilities that not only must be completed as part of the incremental building block approach of the CLCS delivery process but also to provide the capabilities that the user community desires to have as soon as possible in the project.

The Requirements Design Panel and the Detailed Design Panel provides the CLCS project managers through the design panel chairman to monitor and manage/mitigate high level system level architecture issues. This insight to the product development cycle allows a great deal of risk mitigation as it is performed in 'real time' as the incremental capability is provided and the incremental system level requirements are met.